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ABSTRACT

This guide for a mathematics curriculum for grades 1-4 presents topics in sequential order for the entire four-year program. Grade level was not used for separating units; instead, an integrated sequencing of concepts was used in preparing this guide. The relationship between units is specified for the teacher as an explicit mapping of how a particular concept is developed throughout the program. Number concepts, numeration, geometrical concepts, measurement concepts, and operations with whole numbers and fractions are presented in 43 units. Each unit contains a description of the concepts and mathematical activities with which the students are to be presented. Specific performance objectives are also listed. (JP)

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MATHEMATICS

SCOPE and SEQUENCE

GRADES 1-4

IBERVILLE PARISH SCHOOLS

SE 017 800

An Individualized Instructional Program Organized With A Concept Philosophy by Levels for the Iberville Parish School System

Iberville Parish School Board
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LEARNING SEQUENCE 1: Sets--Introduction, Phase A

DESCRIPTION

An introduction to assembling objects into sets is provided in this learning sequence. This skill will enable the student to distinguish between various sets and to understand the meaning of equality. He will be able to compare two sets to determine whether the first set has more than, fewer than, or the same number of elements as the other set. Then he can determine how many more or fewer members the first set has than the second set if they do not have the same number of elements. One-to-one correspondence between two sets should be emphasized. Comparison of the members of two sets (as to color, size, shape, etc.) should be made, and it should be emphasized that the color, size, shape, etc. do not affect the number of members in the set.

LEARNING SEQUENCE 1: Sets--Introduction, Phase A

OBJECTIVES

I. In the study of sets, the student should be able to:

A. Identify a set.

B. Describe a set as a collection of toys, people, objects, etc.

C. Identify the members of a set.

D. Assemble objects into specified sets.

E. Pair the members of two given sets (one-to-one correspondence).

F. Determine which of two given sets has fewer members.

G. Determine which of two given sets has more members.

H. From a collection of sets identify sets that match in number.

I. Describe and illustrate a set which is empty.

J. Determine which of three given sets has the fewest members.

K. Determine which of three given sets has the most members.

II. In working with set operations, the student should be able to:

A. Demonstrate the union of two sets.

B. Separate a set into disjoint subsets.

III. In extending his study of the above concepts and skills, the student should be able to group objects that are alike in size, color or description.

LEARNING SEQUENCE 2: Numeration--Introduction to Numerals

DESCRIPTION

The purpose of this learning sequence is to have the student read and write numerals, with special emphasis placed on the numerals 1, 2, 3, 4, 5, 6, 7, 8, 9. The order in which the numerals appear is also important. Counting objects correctly is essential. Also included in this sequence is the concept of zero, the numeral 0 and its importance in our number system.

LEARNING SEQUENCE 2. Numeration--Introduction to Numerals

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 1.

II. In working with sets, the student should be able to:

A. Identify sets with the same number of elements--one-to-one correspondence.

B. Identify sets with one, two or three members.

C. Identify and describe the empty set.

D. Identify the cardinal number of a given set with no more than nine members by counting.

E. Estimate the number of elements of a set.

F. Demonstrate that the elements of a set can be counted in any order to obtain the cardinal number of the set.

III. By applying number concepts, the student should be able to:

A. Make jumps of one, two, three and five on the number line.

B. Recognize the numerals 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

C. Write the numerals 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.

LEARNING SEQUENCE 3: Geometry, Phase A

DESCRIPTION

In this sequence the student is introduced to plane shapes, lines and points, recognition of basic colors and comparison of and distinction between various shapes. The student will become familiar with the circle, triangle, rectangle and square. Recognition and drawing of these plane figures are important. Emphasis is placed on the concepts of point and line. Recognition of basic colors is applied to grouping in sets, and special mention is made of the colors of the rainbow. The purpose of the comparison of and distinction between the various plane figures is to make the student aware of similarities and differences.

LEARNING SEQUENCE 3: Geometry, Phase A

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 1.

II. In observing physical models of lines and points, the student should be able to:

A. Identify the following:

1. Point.
2. Line segment.
3. Line.
4. Curve.

B. Identify a simple closed curve ( ):

1. From a set of lines and figures.
2. By drawing.

III. In observing models of simple closed curves the student should be able to:

A. Distinguish between the inside and outside of a simple closed curve.

B. Identify and draw the following simple closed curves:

1. Circle.
2. Triangle.
3. Rectangle.
4. Square.

C. Give an identifying property or properities of:

1. A circle.
2. A triangle.
3. A rectangle.
4. A square.

IV. By using the basic colors the student should be able to:

A. Identify the following colors:

1. Red.
2. Orange.
3. Yellow.
4. Green.
5. Blue.
6. Indigo.
7. Violet.

LEARNING SEQUENCE 3: Geometry, Phase A (Continued)

B. Cite the colors of the rainbow.

C. Distinguish between light and dark colors.

D. Distinguish between day and night.

V. In recognizing shapes of objects the student should be able to:

A. Identify difference in shapes of the members of a given set of objects.

B. Identify similarities in shapes of the members of a given set of objects.

LEARNING SEQUENCE 4: Spatial Relationships

DESCRIPTION

In this learning sequence the student becomes aware of the position of an object in space. The concepts of relative position, such as over, under; above, below; front, back; beginning, middle, end; left, right; inside, outside; interior, exterior; are also applied to the development of the concept of opposites (inverses). Comparative concepts such as nearer and farther are introduced.

LEARNING SEQUENCE 4: Spatial Relationships

OBJECTIVES

I. By investigating the concept of position, the student should be able to distinguish between:

   A. Over and under.

   B. Front and back.

   C. Inside and outside.

   D. Center and ends.

   E. Top and bottom.

   F. Left and right.

   G. Up and down.

   H. To and from.

   I. On and off.

   J. High and low.

II. By investigating the concept of relative position, the student should be able to:

   A. Distinguish between nearer and farther.

   B. Identify an object lying between two given objects.

   C. Place an object between two given objects.

LEARNING SEQUENCE 5: *Measure--Introduction to Measurement*

DESCRIPTION

Measurement is introduced to acquaint the student with one system of measure to describe the size, length or value of an object. Among the concepts introduced are relative size, distance, time, money units, weight and liquid measure. Regarding relative size, the student's attention focuses on the concepts of large and small, tall and short, thick and thin, heavy and light, hot and cold. The distance measures of inches, feet, yards and miles are introduced. Time is discussed with the concept of yesterday, today and tomorrow. Second the calendar is introduced to develop the concepts of day, week, month and year. Third, calendar terminology is used to name the days of the week and to name the months of the year. Fourth, the clock is used to introduce the units of hour, minute and second. Recognition of denominations of coins and their values is emphasized. The student is introduced to the English system of weights and liquid measures with applications to everyday living.

LEARNING SEQUENCE 5: Measure--Introduction to Measurement

OBJECTIVES

I. By investigating the concept of distance, the student should be able to distinguish between:

   A. Nearer and farther for the comparison of two measures.

   B. Longer and shorter for the comparison of two measures.

   C. Nearest and farthest when given three or more lengths.

   D. Longest and shortest when given three or more lengths.

II. By investigating the concept of time, the student should be able to:

   A. Distinguish between yesterday and tomorrow compared to today.

   B. Distinguish among morning, afternoon and night.

   C. Identify the following:

      1. Day and week.
      2. Month and year.
      3. Year and decade.

III. Given selected denominations of money, the student should be able to:

   A. Name the following coins:

      1. Penny.
      2. Nickel.
      3. Dime.
      4. Quarter.
      5. Dollar.

   B. Tell the cent value of:

      1. Penny.
      2. Nickel.
      3. Dime.

   C. Tell how much a set of pennies and nickels is worth.

LEARNING SEQUENCE 6: Operations--Fractions as Parts of a Whole

DESCRIPTION

The purpose of this learning sequence is to develop an understanding of the concept of a part relative to the whole. The student becomes aware that things are not always whole and that there is a system and notation to describe those parts of the whole. Words such as all, most, half, some and none are introduced, and the ideas that they represent are developed.

LEARNING SEQUENCE 6: Operations--Fractions as Parts of of Whole

OBJECTIVES

I. By applying the concept of fractional parts, the student should be able to:

A. Demonstrate that things are not always whole.

B. Identify the following by shading when given a set of shapes:

1. All.
2. Most.
3. Some.
4. Nome.
5. A piece.

II. The student should be able to demonstrate an understanding of fractional parts by:

A. Dividing a given figure into two unequal parts, and

1. Identifying the smaller part by shading.
2. Identifying the larger part by labeling it.

B. Dividing a given figure into parts by means of two or more line segements, and

1. Identifying the smallest part of the divided figure by shading (for example,).
2. Identify the largest part of the divided figure by labeling with an X (for example,).

III. In extending his study of the above concepts and skills, the student should be able to:

A. Identify a half of a given object as one of two of its equal-sized parts.

B. Draw a line to divide a circle or rectangle into halves and identify one-half by shading.

1. Four parts.
2. Five parts.
3. Six parts.

LEARNING SEQUENCE 7: Operations--Introduction to Operations with Whole Numbers

DESCRIPTION

In this learning sequence emphasis is placed on joining two sets and separating a set into disjoint subsets. These operations relate to the abstract concept of addition and subtraction of whole numbers. The student is introduced to the notations for operations such as the plus sign (+) and the minus sign (-).

LEARNING SEQUENCE 7: Operations--Introduction to Operations with Whole Numbers

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 1 and 2.

   A. In working with sets, the student should be able to:

      1. Illustrate the union (joining) of two sets.
      2. Illustrate the separating of a set into two or more disjoint sets.

II. In using number facts, the student should be able to:

   A. State the addition facts to 9 orally and in writing.

   B. State the subtraction facts to 9 orally and in writing.

III. In using notation, the student should be able to:

   A. Identify the plus and minus symbols (+ , -).

   B. Use the plus and minus symbols (+ , -).

IV. The student should be able to develop the necessary skills to demonstrate the commutative property for addition:

   A. With sets of objects.

   B. With a number sentence.

V. In extending his study of the above concepts and skills, the student should be able to:

   A. In operations with whole numbers find the cardinal number of the union of two given sets.

   B. In operations with whole numbers solve an equation such as $2 + n = 5$ (for sums less than 10).

LEARNING SEQUENCE 8: Sets, Phase B

DESCRIPTION

In this learning sequence emphasis is placed on the grouping of objects into sets and the comparison of the cardinal numbers of sets. The concepts of equality and inequality are introduced as a result of matching sets. The student is introduced to relations and their notations such as $=$, $\neq$, $<$, $>$. Reinforcement is made of the concept of the empty set. The student is also introduced to notations of subset and set operations.

LEARNING SEQUENCE 8: Sets, Phase B

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 1 and 2.

II. To demonstrate an understanding of grouping, the student should be able to:

A. Specify a set by listing or describing.

B. Identify the elements of a given set.

III. By comparing sets, the student should be able to:

A. Determine whether set A is equivalent to set B.

B. Construct a set with more, fewer or as many members as a given set.

C. Construct a set with exactly one member more or one member less than a given set.

IV. The student should be able to comprehend the concept of the empty set and illustrate with three examples.

V. The student should be able to arrange three or more non-equivalent sets in order, starting with the set containing the fewest members.

VI. The student should be able to compare the cardinal numbers of two sets by means of the symbols $=, >, <, \neq$ For example:

A. $n(A) = n(B)$

B. $n(A) \neq n(B)$

C. $n(A) > n(B)$

D. $n(A) < n(B)$

VII. In extending his study of the above concepts and skills, the studnet should be able to:

A. Identify the union of two given sets.

B. List the subsets of a given set whose cardinal number is less than or equal to 3.

LEARNING SEQUENCE 9: Numeration--Whole Numbers

DESCRIPTION

Numeration and the natural order of whole numbers is stressed in this sequence. Emphasis is placed on the development of skill in reading and writing numerals. The student is introduced to ordinal numbers. The number line is used to reinforce the concept of order of numbers. The student begins to develop an understanding of the decimal system by writing two-digit numerals in expanded notation. He uses his ability to count by ones to learn to count by twos, fives and tens to one hundred.

LEARNING SEQUENCE 9: Numeration--Whole Numbers

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 1, 2, and 8.

II. In order to demonstrate a proficiency in the use of single-digit numbers, the student should be able to:

A. Determine the cardinal number of a set with fewer than ten numbers.

B. Make statements of inequality for numerals 0 to 9.

C. Demonstrate the ability to use ordinal numbers by identifying the first through tenth objects of a set.

D. Identify the smaller of two given one-digit numbers.

E. Identify the larger of two given one-digit numbers.

F. Name the number successor (one greater than) of a specified number.

G. Name the number predecessor (one less than) of a specified number.

III. In order to demonstrate an understanding of two-digit numbers, the student should be able to:

A. Group by tens.

B. Write a two-digit number in standard form (for example, 79).

C. Write a two-digit number in expanded notation (for example, 70 + 9 or 7(10) + 9).

D. Name the decades (10, 20, 30, 40, 50, . . .).

IV. In extending his study of the above concepts and skills, the student should be able to:

A. Distinguish between an odd or even number.

LEARNING SEQUENCE 10: Numeration--Introduction to Numeration Systems

DESCRIPTION

The concepts of the empty set and zero are further reinforced in this unit. Emphasis is placed on face value and place value of the digits in the numbers from zero to one hundred. The student is introduced to the notion of parity by distinguishing between odd and even numbers. A foundation for understanding other numeration systems (bases other than ten) through counting skills (counting by fives, twos and tens) is formed.

LEARNING SEQUENCE 10: Numeration--Introduction to Numeration Systems

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 1, 2, 8, and 9.

II. Given the set of numerals from 0 to 100, the student should be able to:

A. Illustrate the concept to zero (the cardinal number of the empty set).

B. Identify the numerals from 0 to 99.

C. Give the face value of a number.

D. Give the place value of the digits in any numeral from 1 to 100.

III. In extending his study of the above concepts and skills, the student should be able to:

A. Count to 100 orally by:

1. Ones
2. Twos
3. Tens
4. Fives

B. Write the numerals 1 to 100.

C. Fill in the missing numerals when given a sequence between 0 to 100.

D. By citing an example, associate the number two with the notion of:

1. A pair (eyes, shoes, socks, twins).
2. Doubling (double-dip ice cream cone).

LEARNING SEQUENCE 11: Operations--Addition, Phase A

DESCRIPTION

The student develops the concept of addition of numbers by relating addition to the union of two disjoint sets. The equation in which both addends are less than ten is known as a basic addition fact. Memorization of basic facts is an absolute necessity for proficiency in mathematics. Manipulative devices, such as the number line and constant drill, stress reinforcement until memorization is achieved. In developing these facts, five important principles are used. The student is introduced to these basic principles of closure, commutativity, associativity, identity property and the inverse property. Addition of two-digit numbers (without regrouping) is derived by applying those principles. Emphasis is placed on using expanded notation for number representation.

LEARNING SEQUENCE 11: Operations--Addition, Phase A

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 1, 2, 7, 9, and 10.

II. By using the concept of addition (both intuitive and mathematical), the student should be able to:

A. Write the numerals such as 3 + 2 to relate addition to joining two disjoint sets.

B. Name addends and the sum of an addition sentence.

C. Relate sentences such as 1 + 3 = 4 to the joining of two sets.

D. Write the cardinal number of the union of two sets.

E. Use the symbol for plus (+) with the sum of two numbers.

F. Write an addition fact in the standard form of an equation (horizontal form), e.g., 2 + 3 = 5.

G. Solve and equation in standard form such as 2 + □ = 5.

H. Give the addition combinations for sums of ten or less.

I. Write an addition fact in vertical form.

J. Use the identity property such as 5 + 0 = __.

K. Compute the sum of two numbers (up to ten) by means of the number line.

L. Complete an addition table showing sums less than 10.

M. Use the commutative property of addition, e.g., 2 + 3 = 3 + __; 4 + 1 = __ + __.

N. Use the associative property of addition, e.g., (2 + 1) + 3 = 2 + (1 + __).

O. Compute the sum of two-digit numbers where no regrouping is involved.

LEARNING SEQUENCE 11: Operations--Addition, Phase A

OBJECTIVES

P. Write a two-digit numeral in expanded notation.

Q. Use the inverse property of addition.

III. The student should be able to state orally in writing without hesitation the addition facts (less than ten).

IV. In extending his study of the above concepts and skills, the skills, the student should be able to:

A. Reverse sentences such as 3 + 2 + 5 and 5 + 3 + 2.

B. Compute the sum of three addends (using parentheses) such as (4 + 2) + 3
= 6 + 3 = 9

C. Construct an addition table showing sums of twelve or less.

D. Given a picture with two groups of objects, having a specified number of objects, count the number of objects in each group, add the two numbers and state the total number of objects.

LEARNING SEQUENCE 12: Operations--Subtraction, Phase A

DESCRIPTION

The student develops the concept of subtraction of whole numbers by relating subtraction to the separation of sets, and then by using the intuitive idea of taking away. Applying the additive inverse property of addition facilitates the learning of the basic subtraction facts. By solving subtraction sentences the student applies his skill to solving verbal problems. Emphasis is placed on expanded notation, which aids in the understanding of subtraction of two-digit numbers. The student is introduced to writing subtraction problems in vertical form.

LEARNING SEQUENCE 12: Operations--Subtraction, Phase A

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 1, 7, 9, 10 and 11.

II. To demonstrate an understanding of the basic concepts of subtraction, the student should be able to:

A. Express his understanding of the concept of inverse by giving the opposite of specified words such as giving--taking away.

B. Use the idea of taking away.

C. Use the number line to demonstrate the principle of subtraction.

D. Separate a set into smaller sets (subsets).

E. Remove part of a set and state how many members remain.

F. Use the minus sign (-) with the difference of two numbers.

G. Write a subtraction fact in the standard form of an equation (horizontal form) 3 - 1 = 2.

H. Apply the subtraction facts (differences to 10) to simple problems.

I. Solve a simple subtraction statement such as 8 - n = 5; n - 2 = 4.

J. Apply the property of zero to subtraction such as 4 - 4 = __; 3 - 0 = __.

K. Write subtraction facts in vertical form.

L. Demonstrate that subtraction is the inverse of addition by adding the difference and the subtrahend to obtain the minuend.

M. Use expanded notation to show subtraction of two two-digit numbers less than 100 (no borrowing).

N. State the difference of two-digit numbers less than 100 (no borrowing)

LEARNING SEQUENCE 12: Operations--Subtraction, Phase A (Continued)

O. Apply the term difference to the solution of subtraction problems.

III. The student should be able to state orally or in writing without hesitation the subtraction facts (less than 10).

IV. In extending his study of the above concepts and skills, the student should be able to reverse sentences such as $5 - 2 = 3$ and $3 = 5 - 2$.

LEARNING SEQUENCE 13: Problem Solving, Phase A

DESCRIPTION

Opportunity is provided for the student to develop readiness for solving verbal problems by first relating addition and subtraction sentences to pictured problems. He first identifies an appropriate number sentence which applies to a pictured problem; then he develops skill in writing original number sentences to express the ideas of the problem. He reinforces the association of a number sentence with a problem by making up problems that apply to a given number sentence. The concept of associating an equation with a pictured problem is extended to the solution of verbal problems. The student is encouraged to estimate the answer to a problem as well as to develop skill in writing an equation, solving the space equation and arriving at an answer.

LEARNING SEQUENCE 13: Problem Solving, Phase A

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 11 and 12.

II. To demonstrate an understanding of the relationship between addition and subtraction, the student should be able to:

A. Relate addition and subtraction sentences to pictured problems.

B. From a set of sentences, identify the correct number sentence that fits a pictured problem.

C. Write sentences that fit specified problems.

D. Find the missing number in sentences which fit problems.

E. Relate a number sentence to a problem and find the answer.

F. Make up problems that relate to addition and subtraction sentences.

III. To demonstrate that the student can solve a given simple problem, he should be able to decide whether addition or subtraction (or both) is appropriate in the solution of a given problem, write an appropriate number sentence for the problem, solve the number sentence and interpret the solution of the number sentence as a solution of the problem.

LEARNING SEQUENCE 14: Measure and Measurement

DESCRIPTION

Money experiences with pennies, nickels, dimes, quarters, half dollars and dollars along with problems involving these coins are introduced. An introduction to linear measure provides the student with activities associated with measuring lengths. He is exposed to both the English and metric systems of linear maeasure. Using containers holding a cup, a pint, a quart and a gallon, the student gains experience in working with fluid measures. He is taught to determine the weight of an object to the nearest pound. The student reads the clock to the nearest half-hour. The calendar is introduced, and the student becomes acquainted with the names of the days of the week and the months of the year.

LEARNING SEQUENCE 14: Measure and Measurement

OBJECTIVES

I. The student should be able to maintain and utilize basic skill acquired in learning sequence 5.

II. To demonstrate a knowledge of monetary values and U.S. coins, the student should be able to:

A. Name the following coins:

1. Penny.
2. Nickel.
3. Dime.
4. Quarter.
5. Half-dollar.
6. Dollar.

B. Tell the value in cents of penny, nickel, dime.

C. Count money when given two denominations--penny, nickel, dime.

D. Solve simple word problems involving coins.

III. By applying principles of linear measure, the student should be able to:

A. Recognize on a ruler and label:

1. Inch.
2. Foot.
3. Yard.

B. Demonstrate or explain that a foot is 12 inches.

C. Demonstrate or explain that a yard is 3 feet.

D. Demonstrate or explain that a yard is 36 inches.

IV. By applying principles of liquid measure, the student should be able to:

A. Identify the following measures:

1. Cup.
2. Pint.
3. Quart.
4. Gallon.

LEARNING SEQUENCE 14: Measure and Measurement (Continued)

B. Determine the number of cups in a pint and in a quart.

C. Determine the number of pints in a quart and in a gallon.

V. To demonstrate an understanding of weight the student should be able to:

A. Distinguish between ounce and pound.

B. Find the weight of an object to the nearest pound.

VI. To demonstrate an understanding of the concept of time, the student should be able to:

A. Tell time to the nearest hour (one o'clock).

B. Use correct notation for writing time to the nearest hour, e.g., 3 o'clock.

VII. To demonstrate a basic understanding of the calendar, the student should be able to:

A. Name the days of the week.

B. Name the months of the year.

C. Tell the number of days in a week.

D. Tell the number of months in a year.

E. Tell the number of days in a year.

F. Solve simple word problems involving the same unit of time (Joe worked 3 days last week and 2 days this week. How many days did he work?).

VIII. In extending his study of the above concepts and skills, the student should be able to count money involving more than two denominations.

LEARNING SEQUENCE 15: Geometry, Phase B

DESCRIPTION

An informal development of geometry is introduced in this sequence. The student extend their experiences in comparing lengths and in recognizing common geometric shapes to drawing lines, circles, triangles and rectangles. The notions of interior (inside) and exterior (outside) of a simple closed curve are stressed, and the notion of the measure of a line segment is extended to the computation of the perimeter of a simple polygon. The student solves simple geometric problems.

LEARNING SEQUENCE 15: Geometry, Phase B

OBJECTIVES

I. The student should be able to maintain and utilize basic acquired in learning sequence 3.

II. To demonstrate an understanding of the concept of shape, the student should be able to:

   A. Name the properties of a square, a rectangle and a triangle.

   B. Distinguish between the inside and outside of a specified simple closed curve.

III. To demonstrate an understanding of lines, the student should be able to:

   A. Distinguish between lines and line segments.

   B. Compare the lengths of two line segments.

   C. Solve simple problems involving length.

IV. In extending his study of the above concepts and skills, the student should be able to.

   A. Identify a ray.

   B. Identify an angle.

   C. Identify objects that are symmetrical.

LEARNING SEQUENCE 16: Operations--Introduction to Fractions

DESCRIPTION

The student is initially introduced to the numbers one-half, one-third and one-fourth. He learns to identify halves, thirds and fourths of objects and to read the numerals 1/2, 1/3, and 1/4. The notion of fractions is extended to telling time and measuring fractional parts of an inch.

LEARNING SEQUENCE 16: Operations--Introduction to Fractions

OBJECTIVES

I. The student should be able to maintain and utilize basic skill acquired in learning sequences 6 and 15.

II. To demonstrate a basic understanding of fractions the student should be able to:

A. Distinguish between a part and the whole.

B. Identify the following:

1. One-half of an object.
2. One-third of an object.
3. One-fourth of an object.

III. The student should be able to identify and write 1/2, 1/3, and 1/4.

LEARNING SEQUENCE 17: Sets, Phase C

DESCRIPTION

The notion and notation of sets, the equality of sets and operations on sets are reviewed. The concept of matching sets is extended to a many-to-one correspondence. The use of Venn diagrams provides further opportunities to reinforce the concepts of disjoint sets, union of sets, and to introduce the intersection of sets.

LEARNING SEQUENCE 17: Sets, Phase C

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 1, 2, and 8.

II. To demonstrate an understanding of relationships between sets, the student should be able to:

A. Identify the following:

1. Element of a set.
2. Empty set--null set.
3. Cardinal number of a set using the notation n(S).
4. Subset.
5. Equal sets.
6. Equivalent sets.
7. Non-equivalent sets.
8. Disjoint sets.
9. One-to-one correspondence.
10. Symbols =, $\neq$, $<$, $>$, $\emptyset$.

B. Describe the objects in a set when given a set such as [a, b, c] (the first three letters in the alphabet).

C. List the members of a set when given a set, such as the set of all colors of the USA flag; i.e., [red, white, blue]

D. Match equivalent sets--one-to-one correspondence--when given a collection of pairs of sets.

E. State the cardinal number of a given set.

F. Given a collection of pairs of sets, match sets which are in two-to-one correspondence.

G. Determine whether set A has exactly one more element then set B.

H. Distinguish between equivalent and non-equivalent sets.

I. Distinguish between equivalent and equal sets.

III. To demonstrate a knowledge of combining (forming unions) and separating sets, the student should be able to:

LEARNING SEQUENCE 17: Sets, Phase C (Continued)

A. Form the union of sets and state the cardinal number of their union.

B. Name the union of a given pair of sets.

C. Draw a Venn diagram to demonstrate the intersection of two sets which are not disjoint.

D. Determine the intersection of two disjoint sets.

IV. In extending his study of the above concepts and skills, the student should be able to:

A. Match sets which have many-to-one correspondence.

B. Identify a universal set.

C. List the subsets of a given set whose cardinal number is less than or equal to 4.

LEARNING SEQUENCE 18: Measurement--Time

DESCRIPTION

The telling of time is extended to five-minute intervals. Emphasis is placed on the reading of time in print and the writing of time. Using quarter hour designation for telling time is introduced.

LEARNING SEQUENCE 18: Measurement--Time

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 5 and 14.

II. The student should be able to tell time to the hour and to the half hour.

III. To demonstrate a further understanding of time, the student should be able to:

A. Draw the hands of a clock to show a specified time (on the hour or half hour).

B. Read and interpret time in print.

C. Tell time to five-minute intervals.

D. Be able to move the hands to a clock model to a specified time in five-minite intervals

E. Move the hands of a clock model to demonstrate earlier than 8:00 or later than 8:00.

F. Distinguish between A.M. and P.M.

IV. In extending his study of the above concepts and skills, the student should be able to:

A. Match the Roman numberals from I-XII with the Arabic numerals 1-12.

B. Tell time with Roman numerals on the face of a clock.

C. Tell time using quarter-hour disignations, such as "quarter after" or "quarter to."

LEARNING SEQUENCE 19: Numeration and Order

DESCRIPTION

The idea of place value is reviewed and extended to include three-digit numerals. Activities are designed to develop the student's ability to compare and order numbers through 999. Practice in expressing a numeral in various forms also assists in developing understanding of place value. Emphasis is placed on associating the ordinal number with a sequence of objects. The concepts of one-third and one-fourth are reviewed.

LEARNING SEQUENCE 19: Numeration and Order

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 1, 2, 6, 8, 9, 10, 16 and 17.

II. To demonstrate further understanding of numeration, the student should be able to:

A. Group a set of objects by tens.

B. Demonstrate the place value of any digit in a number as large as 100.

C. Read and write three-digit numerals.

D. Demonstrate place value to 1,000.

E. Read and write four-digit numerals.

F. Count to 1,000 by:

1. Ones.
2. Twos.
3. Fives.
4. Tens.
5. Hundreds.

G. Identify the first through the ninth members of a sequence--ordinal numbers.

H. Name the successor (one greater than) and the predecessor (one less than) of a specified number.

I. Write $<$, $>$ or $=$ between pairs of numerals to make true statements from a list of pairs of numerals.

J. Name the most obvious missing members in a sequence of numbers such as 321, 322, ___, ___, 325.

III. To demonstrate a knowledge of numeration of fractions the student should be able to:

A. Identify pictures that are separated into halves, thirds and fourths.

B. Write the fractional numerals 1/2, 1/3, 1/4.

LEARNING SEQUENCE 19: Numeration and Order (Continued)

C. Tell which of two given fractions is greater.

D. Determine 1/2 of 2, 1/2 of 4, 1/4 of 4, etc.

IV. In extending his study of the above concepts and skills, the student should be able to:

A. Read numerals to 1,000,000.

B. Identify pictures that are separated into eights and shade in one-eighth, two-eighths, etc.

C. Draw a figure and divide it into a specified number of fractional parts.

LEARNING SEQUENCE 20: Operations--Addition, Phase B

DESCRIPTION

This sequence provides for a review of the operation of addition and the closure, commutative, associative, identity and inverse properties of addition. An extension of addition provides for adding three- and four-digit addends requiring regrouping as well as those not requiring regrouping. Skill is developed in employing both the horizontal and vertical forms of addition. Emphasis is placed on the ability of the student to state the addition facts without hesitation, both orally and in writing, with a high degree of accuracy.

LEARNING SEQUENCE 20: Operations--Addition, Phase B

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 11 and 13.

II. To demonstrate further understanding of the concept of addition and some properties, the student should be able to:

A. Use the number line to demonstrate the sum of two whole numbers.

B. Write and solve an addition sentence.

C. Apply the identity property to addition problems.

D. Compute the sum of two two-digit numbers by regrouping, i.e.,

$$24 + 32 = (20 + 30) + (4 + 2)$$
$$50 + 6 = 56$$

E. Compute the sum of three-digit numbers by the use of expanded notation.

F. Use the commutative property to compute sums.

G. Use the associative property to compute sums.

H. Compute the sum of three- and four digit numbers without regrouping.

I. Compute the sum of three- and four digit numbers by regrouping.

J. Find the sum of numbers by using the vertical form.

K. Compute the sum of one- to three-digit numbers using 3, 4 or 5 addends and check the sum by adding in the opposite direction, e.g.,

$$\begin{array}{r} 246 \\ 300 \\ \underline{420} \end{array}$$

III. To demonstrate skill in addition, the student should be able to:

A. State orally or write the addition facts, without hesitation, with at least 90% accuracy.

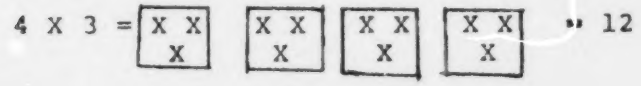
B. Give the sums of column additions with at least 80% accuracy.

LEARNING SEQUENCE 20: Operations--Addition, Phase B (Continued)

IV. In extending his study of the above concepts and skills, the student should be able to:

A. Compute the product of two numbers by repeated addition.

B. Solve multiplication equations with factors of 5 or less using sets and number lines as aids, e.g.,



LEARNING SEQUENCE 21: Measurement--Money and Linear Measure

DESCRIPTION

The principle emphasis in this sequence is on gaining experience in dealing with money and linear measure. The montary value of a set of coins including pennies, nickels, dimes, quarters, half-dollars and dollars is reviewed. Emphasis is placed on being able to make change, to determine the number of nickels equivalent to a specified number of dimes, and to determine the number of dimes equivalent to a specified number of half-dollars, Skill in dealing with money is applied to problems solving. The student is introduced to a technique of measuring line segments. At this level the student uses standard units of measure--the inch.

LEARNING SEQUENCE 21: Measurement--Money and Linear Measure

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 5 and 14.

II. The student should be able to demonstrate an understanding or monetary values and U. S. coins by:

A. Telling how many cents each of the following is worth:

1. Quarter.
2. Half-dollar.
3. Dollar.

B. Telling how many nickels a quarter is worth.

C. Telling how many dimes a half-dollar is worth.

D. Using pennies and dimes to illustrate placevalue of a digit in a numeral.

E. Making change involving dimes, nickels, pennies and quarters.

F. Combining quarters, dimes, nickels, half-dollars and pennies to pay a bill of 97¢.

G. Identifying the cost of an article from a price tag expressed in cents, such as 5¢, 20¢.

H. Determining the individual costs of two or three articles.

I. Solving addition and subtraction problems involving pennies, nickels, dimes, quarters and half-dollars.

III. By using linear measurement principles, the student should be able to:

A. Measure, with a ruler, the lengths of specified objects to nearest inch or half-inch

B. Draw a line segment with length specified in inches and in half-inches.

C. State the number of inches in a foot.

D. Measure the length of a given object in feet and inches.

LEARNING SEQUENCE 21: Measurement--Money and Linear Measure (Continued)

IV. In extending his study of the above concepts and skills, the student should be able to:

A. Express the monetary value of a given set of coins as $2.13.

B. Measure length to the nearest quarter-inch.

C. Convert a measure given in feet and inches to inches.

D. Convert a measure given in inches to feet and inches.

LEARNING SEQUENCE 22: Operations--Subtraction, Phase B

DESCRIPTION

The basic subtraction facts are introduced through the use of a variety of visual and manipulative materials. Reinforcement is accomplished by a variety of practice exercises including the use of related addition sentences. The number line is used to demonstrate subtraction. Emphasis is placed upon the student's ability to state orally and in writing the basic subtraction facts without hesitation. Proficiency in the subtraction of two-digit and three-digit numbers, without regrouping and with regrouping, is attained through practice. The student is encouraged to check subtraction by the inverse operation of addition.

LEARNING SEQUENCE 22: Operations--Subtraction, Phase B

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 11 and 12.

II. To demonstrate a knowledge of subtraction and some properties, the student should be able to:

A. Solve for missing addend, such as $3 + \square = 8$.

B. Use the number line to determine missing addends.

C. Demonstrate that $6 - 0 = 6$, $75 - 0 = 75$, etc.

D. Demonstrate that subtraction is the inverse of addition.

E. Compute the difference of two two-digit numbers without regrouping.

F. Compute the difference of two two-digit numbers with regrouping.

G. Use vertical notation for subtraction.

H. Subtract three-digit numbers.

I. Check subtraction by means of addition.

III. By developing skills in subtraction, the student should be able to:

A. State orally and write without hesitation and aids the subtraction facts.

B. Apply subtraction skills to the solution of problems.

IV. In extending his study of the above concepts and skills, the student should be able to:

A. Compute the difference of two multi-digit numbers.

B. Solve division equations using repeated subtraction, sets and the number line.

LEARNING SEQUENCE 23: Problem Solving, Phase B

DESCRIPTION

Problem solving in this unit includes not only picture problems but also work problems. The student is encouraged to translate a given problem to a number sentence, to solve the sentence and then to translate the solution to the original problem. Developing skill in writing sentences to fit the problem is emphasized. The student is encouraged to estimate an answer to the problem and then to apply his skills (with addition and subtraction) to solve the problem.

LEARNING SEQUENCE 23: Problem Solving, Phase B

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 13.

II. By applying addition and subtraction skills, the student should be able to:

A. Identify an addition sentence that fits a given problem.

B. Identify a subtraction sentence that fits a given problem.

C. Write a sentence to fit a given problem, do the computation and interpret the solution of the sentence as a solution of the original problem.

D. Solve problems involving addition and subtraction without regrouping.

III. The student should be able to estimate the answer before solving the problem.

IV. In extending his study of the above concepts and skills, the student should be able to:

A. Relate multiplication sentences to problems and compute the products.

B. Write an appropriate addition, subtraction or multiplication sentence for a given problem.

LEARNING SEQUENCE 24: Geometry, Phase C

DESCRIPTION

The geometric figures such as circle, triangle, rectangle and square, and their properties are reviewed.

LEARNING SEQUENCE 24: Geometry, Phase C

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 3 and 15.

II. To demonstrate a knowledge of simple figures and simple closed curves of the polygon, the student should be able to:

A. Make a picture of a right angle (square corner) by:

1. Drawing with a straight edge.
2. Paper folding.

B. Identify the right angles in a given figure.

C. Identify a square as a special kind of rectangle.

D. Make a conjecture about a specified polygon such as:

1. The opposite sides of a rectangle are equal in length.
2. All sides of a square are of the same length.

E. Draw a right angle, and copy a right angle.

F. Draw a rectangle, and copy a rectangle.

G. Given a set of various geometric figures, identify those shapes which are different and explain why they are different.

LEARNING SEQUENCE 25: Measurement--Liquid Measure and Dry Measure

DESCRIPTION

The study of measure is extended in this sequence. Half-pint, pint, quart, half-gallon and gallon containers are used to measure liquids and certain solids such as sand or strawberries. Comparision is made between quarts and half-gallons and between quarts and gallons. The student is introduced to units of weight, such as ounce and pound, which he employs in determining the weight of an object. Measurement experience with reading a Fahrenheit thermometer is introduced. The concepts of dozen and half-dozen are also introduced.

LEARNING SEQUENCE 25: Measurement--Liquid Measure and Dry Measure

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 14 and 16.

II. To demonstrate a working knowledge of liquid measure, the student should be able to:

A. Identify the following containers:

1. Cup (half-pint).
2. Pint.
3. Quart.
4. Half-gallon.
5. Gallon.

B. Tell how many cups of liquid such as water, or solid such as sand make a pint.

C. Tell how many cups make a quart.

D. Tell how many quarts make a half-gallon.

E. Tell how many quarts make a gallon.

F. Compare the above measures.

III. To demonstrate a working knowledge of dry measures, the student should be able to:

A. Distinguish between pound and ounce.

B. Use a common scale to find the weight of an object to the nearest pound.

C. Tell how many ounces make a pound.

IV. To demonstrate a knowledge of thermometer and temperature, the student should be able to:

A. Distinguish between thermometer and temperature.

B. Identify a degree.

C. Recognize and use the notation for degree.

D. Read a thermometer (Fahrenheit) and tell the temperature to the nearest degree.

LEARNING SEQUENCE 25: Measurement--Liquid Measure and Dry Measure (Continued)

V. To demonstrate an understanding of the concept of dozen, the student should be able to:

A. Identify a set with one dozen members.

B. Identify a set with one-half dozen members.

C. Construct a set with one dozen members.

D. Construct a set with one-half dozen members.

VI. In extending his study of the above concepts and skills, the student should be able to:

A. Convert measure in quarts to measure in pints.

B. Convert measure in gallons and half-gallons to measure in quarts.

C. Read the thermometer when the temperature is below zero.

D. Separate a set of objects into dozens and fractional parts of a dozen.

LEARNING SEQUENCE 26: Sets, Phase D

DESCRIPTION

The notion of sets and some relationships between sets and the operations on sets are reviewed. The student studies finite and infinite sets and operations of union, intersection and complementation. Emphasis is placed upon concepts and notation. The concepts are further reinforced by use of Venn diagrams.

LEARNING SEQUENCE 26: Sets, Phase D

OBJECTIVES

I. The student should be able to maintain and utilize basic s skills acquired in learning sequences 1, 8 and 17.

II. To demonstrate a knowledge of sets and terminology, the student should be able to:

A. Name the cardinal number of a set using the notation $n(A) = 5$.

B. Designate the universal set by description or figure and use the letter U to denote it.

C. Identify the empty set $\emptyset$.

D. Identify a pair of disjoint sets by description or figure.

E. Distinguish between finite and infinite sets and give an example of each.

F. Differentiate between equal and equivalent sets and give an example of each.

III. To demonstrate an ability to relate sets and to operate on sets, the student should be able to:

A. Make a comparison of two sets, such as:

1. $n(A) = n(B)$
2. $n(A) < n(B)$
3. $n(A) > n(B)$
4. $n(A) \neq n(B)$

B. Identify the union of two given disjoint sets.

C. Identify the intersection of two given disjoint sets as the empty set.

D. Identify the parts of a Venn diagram, such as:

1. Union of two given sets.
2. Intersection of two given disjoint sets.
3. Disjoint sets.

IV. To demonstrate the use of set notation, the student should be able to:

A. Use braces to designate a set, such as [a,b].

LEARNING SEQUENCE 26: Sets, Phase D (Continued)

B. Indicate the union of two sets A and B by the symbol $A \cup B$.

C. Indicate the intersection of two sets A and B by the symbol $A \cap B$.

V. In extending his study of the above concepts and skills, the student should be able to:

A. Use sets of objects to determine equivalent fractional numerals.

B. Distinguish between proper and improper subsets and give an example of each.

C. Use the symbol to indicate "is a subset of."

D. Explain and demonstrate the notion of the complement of a set (with respect to the universal set).

LEARNING SEQUENCE 27: Numeration--Whole Numbers, Fractional Numbers

DESCRIPTION

This sequence provides review and development of the following basic concepts: number, numeral, decimal numeration system, order of numbers and relations of numbers. The student is introduced to the Roman numeration system and to the base five numeration system. Fractions are introduced and developed through the use of physical interpretations. The interpretations could be described by the phrases "parts of the whole," "parts of sets of objects," and "points on a number line." The student is exposed to the notion that fractional numerals are used to name fractions (but can name whole numbers as well). Incorporated in this sequence is the notion of rounding numbers to the nearest ten and to the nearest hundred.

LEARNING SEQUENCE 27: Numeration--Whole Numbers, Fractional Numbers

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 2, 6, 9, 10 and 16.

II. To demonstrate an understanding and working knowledge of numbers, place value and ordinal numbers, the student should be able to:

A. Read and write a given numeral from one to one million.

B. State which of two given numbers is the greater.

C. State which of a set of inequalities are true statements.

D. Write inequalities, such as $243 > 229$.

E. Express a given numeral in expanded notation.

F. Recognize the word for a number such as eighty-seven for 87.

G. Recognize that place value is used in the Hindu-Arabic system but not in the Roman system.

H. Count by tens, hundreds and thousands to one million.

I. Identify and read Roman numerals from one to fifty.

J. Express the numbers less than 20 (in base ten) as numbers in base five.

K. Write an ordinal number for each of a series of cardinal numbers.

III. To demonstrate a proficiency in the use of fractions, the student should be able to:

A. Name and write the fractional number to tell what part of a figure is shaded.

B. Draw a picture to represent a fraction of a counting number.

C. Tell which of two fractional numerals, with a numerator of 1, such as 1/2, 1/3, 1/4, 1/5, names the grester number.

LEARNING SEQUENCE 27: Numeration--Whole Numbers, Fractional Numbers

OBJECTIVE:

D. Use sets of objects to determine equivalent fractional numerals.

E. Write at least two different fractional numerals for one-half, for one-third, for one-fourth, for one-eighth.

F. Recognize that the fractional numeral $\frac{n}{n}$ represents the whole number 1.

G. Associate a given fraction with a point on the number line, and determine which of two fractions on the number line is greater.

H. Determine that 1/3 of 6 is 2, 1/2 of 12 is 6, etc.

IV. To demonstrate that he can round off numbers, the student should be able to:

A. Round off a given number less than one hundred to the nearest 10.

B. Round off a given number less than 1,000 to the nearest 100.

V. In extending his study of the above concepts and skills, the student should be able to:

A. Interpret a fraction as an indicated division (3/4 is the same as $3 \div 4$).

B. The student should be able to compute the sum of fractional numbers having the same denominator.

LEARNING SEQUENCE 28: Operations--Addition and Subtraction

DESCRIPTION

This sequence includes a review of basic addition facts and the related subtraction facts. The commutative and associative properties are reviewed and used in the redevelopment of basic addition facts. Addition of thousands, hundreds, tens and ones with sums less than 10,000 is developed. Regrouping in ones, tens and hundreds, is emphasized. Subtraction with regrouping is redeveloped and extended to hundreds and thousands. Skills developed in addition and subtraction and applied to problem solving.

LEARNING SEQUENCE 28: Operations--Addition and Subtraction

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 11, 12, 20 and 22.

II. To demonstrate an understanding of addition and subtraction, the student should be able to:

A. Show that he knows the basic addition facts and related subtraction facts.

B. State basic addition and subtraction facts in rapid response drill or testing in writing or orally.

C. Define and illustrate the closure, commutative and associative properties of addition.

D. Represent a given addition or subtraction problem on a number line.

E. Subtract three-digit or four-digit numbers (without regrouping).

F. Use regrouping to add several four-digit numbers.

G. Use regrouping to subtract four-digit numbers.

III. To show that he can apply addition and subtraction to problem solving, the student should be able to:

A. Solve a given addition problem involving units of measure (liquid, linear, time, etc.).

B. Solve a given subtraction problem involving units of measure (liquid, linear, time, etc.).

C. Apply the operations of addition and subtraction to problem solving by:

1. Deciding which operation to use.
2. Writing the correct equation and solving it.
3. Judging whether the answer is reasonable in the the original problem.

IV. In extending his study of the above concepts and skills, the student should be able to:

A. Identify patterns in addition and subtraction, such as 45, 42, 39, __, __, __ or 45, 49, 53, __, __, __.

LEARNING SEQUENCE 28: Operations--Addition and Subtraction (Continued)

B. Compute the sum of multi-digit numbers in column form, and check by adding in reverse order.

C. Compute the difference of multi-digit numbers (for example, 671,543 - 29,768).

LEARNING SEQUENCE 29: Operations--Multiplication

DESCRIPTION

The interpretation and development of multiplication as an operation and its relationship to division are the principal ideas in this learning sequence. Emphasis is on helping the student acquire a mastery of the basic multiplication facts. The commutative property of multiplication and the distributive property of multiplication over addition help the student to learn new multiplication facts. The multiplication algorithm is developed. Various forms, including the expanded numeral form, the partial products form and the short form of multiplication are used. The associative property is employed to establish multiplication of a number by multiples of ten and of one hundred. Skills developed in multiplication are applied to problem solving.

LEARNING SEQUENCE 29: Operations--Multiplication

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 20.

II. To demonstrate an understanding of the basic concept of multiplication, the student should be able to:

A. Multiply by using successive addition.

B. Identify the factors and product in a multiplication sentence.

C. Use the following properties to simplify multiplication:

1. Commutative.
2. Associative.
3. Distributive.

D. Discover multiplication facts by using the distributive property and known facts such as:

$$\begin{aligned} 3 \times 9 &= 3 \times (4 + 5) \\ &= (3 \times 4) + (3 \times 5) \\ &= 12 + 15 \\ &= 27. \end{aligned}$$

E. Identify 1 as the identity element for multiplication.

F. Use a multiplication table to determine a missing factor.

G. Multiply by 10, 100, 1000, etc.

H. Multiply one- or two-digit numbers in horizontal form by use of:

1. The distributive property:

$$\begin{aligned} 8 \times 34 &= 8 \times (30 + 4) \\ &= (3 \times 4) + (3 \times 5) \\ &= 12 + 15 \\ &= 27. \end{aligned}$$

2. The expanded numeral form:

$$\begin{array}{r} 30 + 4 \\ \times\ 8 \\ \hline 240 + 32 = 272 \end{array}$$

3. The partial-products form:

$$\begin{array}{r} 34 \\ \times\ 8 \\ \hline 32 \quad (8 \times 4) \\ 240 \quad (8 \times 30) \\ \hline 272 \end{array}$$

LEARNING SEQUENCE 29: Operations--Multiplication (Continued)

III. To demonstrate his skill in multiplication, the student should be able to:

A. Name, without hesitiation, the product to single-digit multiplication combinations.

B. When given a multiplication problem and its product, check the problem by reversing the order of the factors and multiplying again.

C. Applying the skills developed in multiplication to problem solving.

IV. In extending his study of the above concepts and skills, the student should be able to:

A. Multiply a multi-digit number by a single-digit number.

B. Compute a product of factors, each factor having at least two digit.

C. Identify the multiplier and the multiplicand.

LEARNING SEQUENCE 30: Operations--Division

DESCRIPTION

Division, as an operation, is defined in terms of multiplication. It is associated with identifying the missing factor in multiplication sentence. However, repeated subtraction is also used in these initial developments. Division facts are established through the use of related multiplication sentences. The symbol $\overline{)\quad}$ is used in an algorithm for computing the quotient and the remainder. Division is extended to include dividends between 100 and 1,000 and divisors less than 10.

LEARNING SEQUENCE 30: Operations--Division

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 22

II. To demonstrate an understanding of division, the student should be able to:

A. Demonstrate division as successive subtraction.

B. Recognize that division is the inverse of multiplication.

C. Recognize and identify the symbols used in division.

D. Identify the dividend, divisor and quotient of a division sentence.

E. Associate the division sentence 10 ÷ 5 with a question such as, "How many sets of 5 are there in a set of 10 objects?"

F. Use the standard algorithm to divide a whole number by a whole number when the remainder is:

1. Zero.
2. Non-zero.

G. State the division facts, using the inverse of the multiplication facts throught 144.

H. Apply division skills to problem solving.

I. Check the result of a division example by multiplication.

III. To demonstrate skill in the use of division, the student should be able to give the division facts in rapid succession both orally and in writing.

IV. In extending his study of the above concepts and skills, the student should be able to divide a three- or four-digit number by a two-digit number, with a remainder equal to zero or not equal to zero.

LEARNING SEQUENCE 31: Problem Solving, Phase C

DESCRIPTION

This sequence provides a review of writing number sentences for given problems. The student developes skill in selecting data from general statements in order to answer questions asked. Emphasis is on estimating the answer before solving the problem.

LEARNING SEQUENCE 31: Problem Solving, Phase C

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 13 and 23.

II. To demonstrate his ability to solve simple problems, the student should be able to:

A. Given a list of sentences, tell which sentences best fits a problem.

B. Write a related subtraction sentences for a given addition sentences.

C. Write a related addition sentence for a given subtraction sentence.

D. Compute the numerical answer to a problem.

E. Determine if the information given in a problem is sufficient; determine the operations required to solve the problem; solve the problem.

F. Utilize data outside of the problem such as a year is composed of 12 months.

G. Select only the necessary data to answer the question, write the sentence that best fits the problem and solve for a numerical answer.

H. Estimate the answer to a given problem and check the answer.

III. In extending his study of the above concepts and skills, the student should be able to solve problems involving two steps and two operations.

LEARNING SEQUENCE 32: Geometry, Phase D

DESCRIPTION

The student develops ability to recognize geometric figures and learns how to draw them. He develops the geometric concepts informally and by generalizing from a sequence of observations which may or may not depend on measurement. As a figure is studied, certain properties become evident. Emphasis is placed upon straight lines (perpendicular, parallel and intersecting) and simple closed curves. The student is exposed to geometric solid figures and is made aware of their presence in the world about him. The area of a simple closed curve is introduced in this sequence.

LEARNING SEQUENCE 32: Geometry, Phase D

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 3, 15 and 74.

II. To demonstrate a working knowledge of points and lines, the student should be able to:

A. Distinguish between a line segment and a ray.

B. Draw parallel, intersecting and perpendicular lines.

C. Identify the point(s) of intersection of two circles.

D. Identify the point(s) of intersection of a circle and a polygon.

E. Identify the point(s) of intersection of a circle and a line.

III. To demonstrate an understanding and working knowledge of basic polygons, the student should be able to:

A. Distinguish between open and closed curves.

B. Select symmetrical figures from a given set of figures.

C. Identify the following simple closed curves:

1. Triangle.
2. Rectangle.
3. Square.

D. Copy a triangle by using a protractor and an unmarked straight edge.

E. Construct a figure to accompany a given problem.

F. Identify and describe certain congruent figures.

IV. To demonstrate an understanding of properties of circles, the student should be able to:

A. Identify and draw the parts of a circle.

V. To demonstrate a working knowledge of three-dimensional (solid) figures, the student should be able to:

LEARNING SEQUENCE 32: Geometry, Phase D (Continued)

A. Identify the following solid figures:

1. Sphere.
2. Cone.

B. Cite an example of the above in everyday life.

VI. In extending his study of the above concepts and skills, the student should be able to:

A. Distinguish between convex and concave figures.

B. Determine the area of a rectangle and of certain other simple closed curves.

LEARNING SEQUENCE 33: Measurement--Measuring Linear Measures, Weight and Temperature

DESCRIPTION

Concepts presented in this sequence include measuring line segments and drawing line segments of specified length. These skills are applied to finding the measures of the sides of a polygon and computing the perimeter and to drawing a polygon of a specified size. Linear measures are expressed in centimeters and quarter-inches. Weight is measured to the nearest ounce. Fahrenheit scale is used to measure temperature. The student develops skill in reading and locating dates on the calendar.

LEARNING SEQUENCE 33: Measurement--Measuring Linear Measures, Weight and Temperature

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 5, 14, 21 and 25.

II. To demonstrate an understanding of measurement and length, the student should be able to:

A. Estimate the length of an object in inches.

B. Measure the length of an object to the nearest quarter-inch.

C. Measure the sides, and compute the perimeter of a polygon of three or more sides.

III. To demonstrate an understanding of measurement and weight, the student should be able to:

A. Determine the weight of a given small object to the nearest ounce.

B. Express in pounds and ounces a weight of more than 16 ounces.

C. Express in ounces a weight given in pounds and ounces.

IV. To demonstrate an understanding of measurement and temperature, the student should be able to:

A. Read a thermometer using Fahrenheit scale.

B. Identify the freezing point and the boiling point of water on each scale.

C. Compute changes in temperature from given data.

V. To show that he can use the calendar properly, the student should be able to:

A. Explain the relationships of days, weeks, months, years.

B. Locate a given date on the calendar.

VI. To show that he can determine time by identifying the following:

LEARNING SEQUENCE 33: Measurement--Measuring Linear Measures, Weight and Temperature (Continued)

A. Hour.

B. Half hour.

C. Quarter of hour.

D. Minutes.

LEARNING SEQUENCE 35: Sets, Phase E

DESCRIPTION

This learning sequence provides the student with a review of set concepts, language and notation. The study of sets will afford the student a better understanding of the concepts of numbers and arithmetic. The union of disjoint sets provides a model for addition of whole numbers, and partitioning a set provides a model for subtraction of whole numbers. Set concepts are used also in the study of geometry, since all geometric figures are sets of points.

LEARNING SEQUENCE 35: Sets, Phase I

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 1, 8, 17, 24, and 26.

II. To demonstrate an understanding of the concept of sets, the student should be able to:

A. Define the following particular sets:

1. Subset of a set.
2. Universal set.
3. Empty set.
4. Finite set.
5. Infinite set.

B. Use a sentence to describe the elements of a set.

III. To relate sets to numbers, the student should be able to:

A. Decide whether the members of two given sets A and B can be paired so that each member of A corresponds to exactly one member of B, and each member of B corresponds to exactly one member of A.

B. Define one-to-one correspondence.

C. Recognize that two given sets A and B which can be put into a one-to-one correspondence have the same cardinal number.

D. Identify A and B as equivalent sets if the cardinal number of A is equal to the cardinal number of B.

E. Pair the members of two given sets A and B to determine whether:

1. Set A has fewer members than set B.
2. Set A has the same number of members as set B.
3. Set A has more members than set B.

F. Define A = B if, and only if, A and B contain exactly the same members regardless of the order of listing.

IV. By using set operations, the student should be able to:

A. Define and illustrate the union of sets A and B ($A \cup B$).

LEARNING SEQUENCE 35: Sets, Phase E (Continued)

B. Define and illustrate the intersection of A and B ($A \cap B$).

C. Separate a set into two or more disjoint subsets.

V. In extending his study of the above concepts and skills, the student should be able to:

A. Relate set concepts to the study of geometric figures in a plane, all of which are sets of points.

1. Point.
2. Line segment.
3. Line.
4. Ray.
5. Angle.
6. Simple closed curve.
7. Open curve.
8. Circle.
9. Square.
10. Rectangle.

B. Partition a set into disjoint subsets in which all disjoint subsets are equivalent and also in which not all disjoint subsets are equivalent.

C. Illustrate the commutative and associative properties for union. For example, $A \cup B = B \cup A$ and $A \cup (B \cup C) = (A \cup B) \cup C$.

D. Illustrate the commutative and associative properties for intersection. For example, $A \cap B = B \cap A$ and $A \cap (B \cap C) = (A \cap B) \cap C$.

E. Illustrate the distributive property for intersection over union. For example, $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$.

F. Illustrate the distributive property for union over intersection. For example, $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$.

LEARNING SEQUENCE 36: Numeration Systems, Phase A

DESCRIPTION

In this learning sequence, special emphasis is placed upon place value and face value. The student develops an understanding of our numeration system and the properties and symbols used in the Roman numeration system. It also includes an introduction to the base four numeration system, Egyptian symbols for numbers and reading and writing numbers through hundred millions.

LEARNING SEQUENCE 36: Numeration Systems, Phase A

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 2, 9, 10, 18 and 27.

II. To demonstrate an understanding of the base ten numeration system, the student should be able to:

A. Distinguish between face value and place value.

B. Recognize that the decimal numeration system is a place value system.

C. Recognize that each digit in a numeral has a place value ten times as great as the place value of the digit to its right.

D. Write decimal numerals in expanded form. Example: 2407 = (2 X 100) + (4 X 100) + (0 X 10) + (7 X 1).

E. Group the digits of a decimal numeral into periods.

F. Read and write decimal numerals through the hundred millions place.

III. To demonstrate an understanding of the Roman numeration system, the student should be able to:

A. Express the following basic Roman symbols as decimal numerals:

1. I.
2. V.
3. X.
4. L.
5. C.
6. D.
7. M.

B. Distinguish between place value of the decimal system and fixed value of the Roman system.

C. Use the additive principle for repeated Roman symbols. For example, XXX = 10 + 10 + 10 = 30.

D. Use additive and subtractive procedures to express Roman numerals as decimal numerals, e.g., VI = 5 + 1 = 6 and IX = 10 - 1 = 9

E. Read and write Roman numerals up to 100.

LEARNING SEQUENCE 36: Numeration Systems, Phase A (Continued)

IV. To demonstrate an understanding of the base four numeration system, the student should be able to:

A. Partition a given set of objects into as many disjoint subsets of four members each as possible and tell how many objects remain.

B. Partition a set of fourteen objects into subsets of four members each and tell how many objects remain, and:

1. Decide how many subsets contain four members each.
2. Decide how many members the remaining subset contains.
3. Express fourteen as 32_{four}.

V. In extending his study of the above concepts and skills, the student should be able to:

A. Partition a given set of nine coins into subsets of 3 quarters, 2 nickels and 4 pennies.

B. Realize that 3q 2n 4p could be expressed as 324_{five} and means 3 quarters, 2 nickels and 4 pennies, which is 89¢; thus, $324_{five} = 89_{ten}$.

LEARNING SEQUENCE 37: Operations--Addition and Subtraction of Whole Numbers, Phase A

DESCRIPTION

This learning sequence consists of the development and understanding of the closure, commutative, associative and identity properties of addition. Other topics considered are estimating sums and differences, addition and subtraction as inverse operations, number sentences and number patterns.

LEARNING SEQUENCE 37: Operations--Addition and Subtraction of Whole Numbers, Phase A

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequence 28.

II. To demonstrate an understanding of addition and subtraction, the student should be able to:

A. State and illustrate the closure property for addition.

B. Identify zero as the identity element of addition, and state and illustrate the identity property for addition ($a + 0 = a$).

C. State and illustrate the commutative property for addition.

D. State and illustrate the associative property for addition.

E. Demonstrate that there is no closure property, no identity property, no commutative property and no associative property for subtraction of whole numbers.

F. Explain that $a - 0 = a$, but $0 - a \neq a$ for any whole number a if a is not zero.

III. To demonstrate an understanding of inverse operations, the student should be able to:

A. Explain why addition and subtraction are inverse operations.

B. Estimate the sums of whole numbers, and then compute the exact differences.

IV. To demonstrate an understanding of addition and subtraction, the student should be able to:

A. Solve simple money problems using four- and five-digit numerals.

B. Identify patterns in addition and subtraction.

C. Decide whether a given sentence involving whole numbers is true or false.

LEARNING SEQUENCE 37: Operations--Addition and Subtraction of Whole Numbers, Phase A (Continued)

D. Estimate differences of whole numbers (weights, heights, distances).

V. In extending his study of the above concepts and skills, the student should be able to:

A. Solve money problems with six- and seven-digit numerals using addition and subtraction.

B. Construct number sentences which are true.

C. Construct number sentences which are false.

LEARNING SEQUENCE 38: Operations--Multiplication and Division of Whole Numbers, Phase A

DESCRIPTION

In this learning sequence the student studies multiplication and division of whole numbers as inverse operations, and considers the properties of multiplication and division. Other topics presented are estimating answers by rounding of whole numbers, patterns, problem solving and number sentences.

LEARNING SEQUENCE 38: Operations--Multiplication and Division of Whole Numbers, Phase A

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 29 and 30.

II. To demonstrate an understanding of the properties of multiplication and division, the student should be able to:

A. State and illustrate the closure property of multiplication.

B. Identify 1 as the identity property for multiplication, and state and illustrate the identity property for multiplication ($a \times 1 = a$).

C. State and illustrate the commutative property for multiplication.

D. State and illustrate the associative property for multiplication.

E. Demonstrate that there is no closure property, no identity property, no commutative property and no associative property for division of whole numbers.

F. Explain that $a \div 1 = a$, but $1 \div a \neq a$ for any whole number a if a is not one.

G. State and illustrate the multiplication property of zero.

III. To demonstrate an understanding of inverse operations, the student should be able to:

A. Explain that multiplication and division are inverse operations.

B. Estimate the products of whole numbers; then compute the exact products.

C. Estimate the quotients of whole numbers; then compute exact quotients (provided the remainder is 0).

IV. To demonstrate a working knowledge of multiplication and division, the student should be able to:

A. Solve simple money problems.

B. Identify patterns in multiplication and division.

LEARNING SEQUENCE 38: Operations--Multiplication and Division of Whole Numbers, Phase A (Continued)

C. Decide whether a given sentence involving whole numbers is true or false.

D. Estimate quotients of whole numbers (miles per gallon, money per child, etc.).

V. In extending his study of the above concepts and skills, the student should be able to:

A. Construct number sentences which are true.

B. Construct number sentences which are false.

LEARNING SEQUENCE 39: Operations--Addition and Subtraction of Fractional Numbers

DESCRIPTION

This learning sequence develops an understanding of fractional numbers. The operations of addition and subtraction of like fractions are introduced. Similarities and differences between operations involving whole numbers and operations involving fractional numbers are discussed.

LEARNING SEQUENCE 39: Operations--Addition and Subtraction of Fractional Numbers

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 6 and 16.

II. To demonstrate an understanding of fractional numbers, the student should be able to:

A. Read fraction words and numerals.

B. Match fractions expressed as words and numerals.

C. Write numerals for fractions.

D. Give the meanings of numerator and denominator.

E. Compute a set of fractions, each equivalent to a given fraction.

F. Reduce a fraction to lowest terms.

G. Recognize proper fractions, improper fractions and mixed fractions.

H. Order fractions on a number line.

III. To demonstrate a working knowledge of fractions, the student should be able to:

A. Add fractions with the same denominator by using:

1. The vertical form.
2. The horizontal form.

IV. To demonstrate that he can subtract fractions with the same denominator, the student should be able to:

A. Subtract fractions with the same denominator by using:

1. The vertical form.
2. The horizontal form.

B. Rename fractions with different denominators in order to subtract them as fractions with the same denominator.

V. In extending his study of the above concepts and skills, the student should be able to analyze and solve problems involving fractions.

LEARNING SEQUENCE 40: Measurement--English and Metric Systems, Phase A

DESCRIPTION

This learning sequence consists of the study of the English and metric systems of measure--linear, dry, liquid, weight, time and temperature. A comparison of the two systems is made and measurements are converted from one system to the other.

LEARNING SEQUENCE 40: Measurement--English and Metric Systems, Phase A

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learing sequences 5, 14, 18, 21, 25, 33, and 34.

II. To demonstrate the ability to use various units of measure, the student should be able to:

A. Measure the length of a physical object to the nearest one inch, 1/2-inch, and 1/4-inch.

B. Measure dimensions of a rectangle object.

C. Measure weights in pounds and ounces.

D. Express weight of a Boeing 747 in tons and pounds.

E. Measure capacity of liquids and write results as gallons, quarts, pints, cups and ounces.

F. Read time to the nearest minute.

G. Express time in two different ways. (For example, 3:40 P.M. or twenty minutes until 4:00 P.M.)

H. Express the period of time that has elapsed since the landing of Apollo 11 on the moon (in years, months and days).

I. Identify on a thermometer the boiling point and the freezing point of water (on Fahrenheit and Centigrade [Celsius] thermometers).

III. To demonstrate the ability to solve simple problems, the student should be able to:

A. Solve problems involving inches, feet and yards.

B. Solve problems involving ounces, and pounds.

C. Solve problems involving fluid ounces, pints, quarts and gallons.

IV. To demonstrate a working knowledge of the metric system the student should be able to:

A. Contrast and compare the metric system of measurement and the English system of measurement.

LEARNING SEQUENCE 40: Measurement--English and Metric Systems, Phase A (Continued)

B. Identify the following:

1. The meter as the basic unit of length in the metric system.
2. The liter as the basic unit of volume in the metric system.
3. The gram as the basic unit of mass in the metric system.

C. Define the following prefixes that are used in the metric system:

1. Milli-
2. Centi-
3. Deci-
4. Deca-
5. Hecto-
6. Kilo-

LEARNING SEQUENCE 41: Geometry, Phase E

DESCRIPTION

This learning sequence deals with geometric concepts and with relationships among geometric figures. Properties of simple closed curves are investigated. Experiences with solid figures are provided.

LEARNING SEQUENCE 41: Geometry, Phase E

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 3, 15, 24 and 32.

II. To demonstrate a working knowledge of non-metric geometry, the student should be able to:

A. Identify and construct models of:

1. Points, line segments, rays, and lines.
2. The following planes and simple closed curves:
   a. Rectangle.
   b. Square.
   c. Triangle.
   d. Circle.
3. The following angles:
   a. Acute.
   b. Right.
   c. Obtuse.
4. Intersecting lines.
5. Parallel lines.

III. In metric geometry, the student should be able to:

A. Measure or compute the perimeters of the following simple closed curves:

1. Rectangle.
2. Square.
3. Triangle.
4. Circle (circumference).

B. Measure or compute the area of the interior of a simple closed curve in square inches, square feet and square centimeters.

LEARNING SEQUENCE 42: Graphs and Probability, Phase A

DESCRIPTION

This learning sequence deals with reading and making bar graphs, line graphs, and picture graphs. The concept of probibility is introduced.

LEARNING SEQUENCE 43: Problem Solving, Phase D

DESCRIPTION

In this sequence the student is able to construct mathematical models for problems by writing number sentences. The idea of more than one operation being used in a single sentence is extended to include all four operations. The student is able not only to compute answers for these sentences, but also to construct multiple-operational sentences from information given in a problem.

LEARNING SEQUENCE 43: Problem Solving, Phase D

OBJECTIVES

I. The student should be able to maintain and utilize basic skills acquired in learning sequences 13, 23, and 31.

II. To demonstrate an ability to solve simple problems, the student should be able to:

A. Read a description of a physical problem and decide whether a mathematical model is appropriate.

B. Construct a mathematical model of the given problem (i.e., a number sentence or set of sentences which fit or seem to fit the given problem).

C. Solve the mathematical model.

D. Interpret the solution of the mathematical model as a solution of the given physical problem.

E. Check the solution in the given physical problem.

F. Decide whether the model is appropriate.

III. The student should be able to estimate answers to exercises and problems.